Mobile Networked MIMO (MNM) Program

16 March 2006

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The Military Needs New Radio Technology

Our user needs more bandwidth and better reliability

Little Has Changed in Radio Physical Layers Over the Last Several Decades

- **Primarily Voice Comms**
- **Same Bands, Same Bandwidths** (though smaller and more secure)
- **Digital Modulations Have Replaced Analog, but Little Change in Functionality**

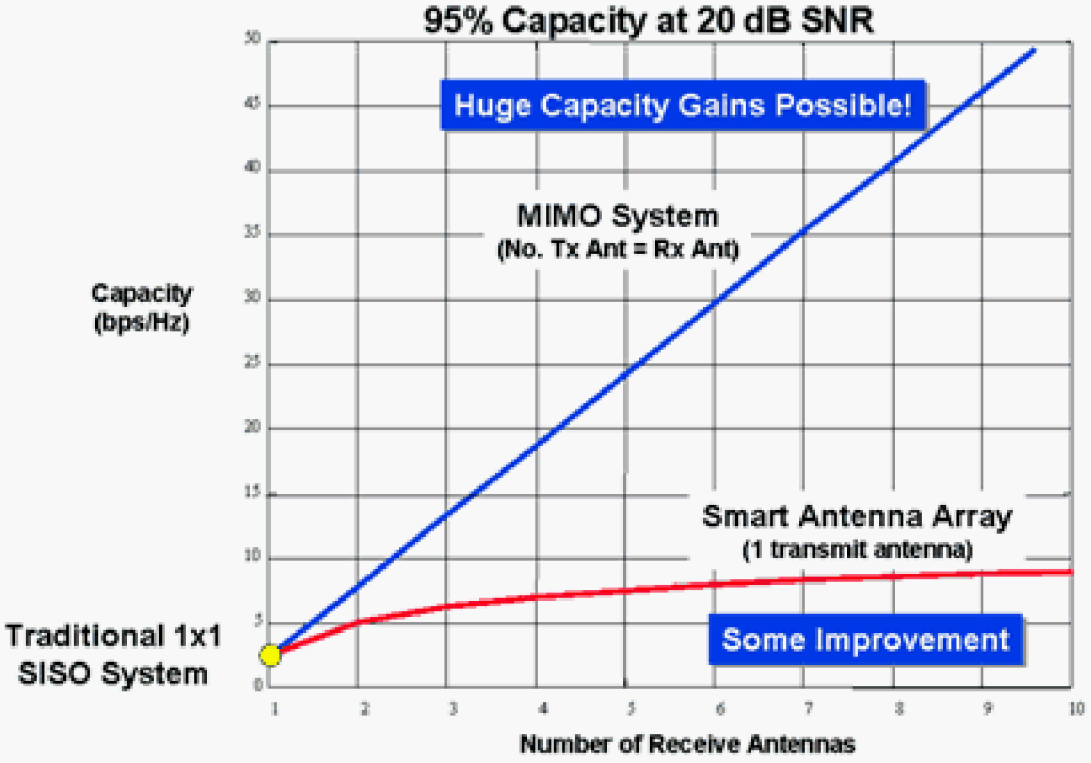
No Significant Physical Layer Innovations in the Acquisition Pipeline

- **Same Bands, Same Bandwidths** (though some additional networking and throughput)
- **No Additional Range Over Existing Radios**
- **Spectral Efficiency Still Poor**

Mobile Networked MIMO is the answer!

Mobile Networked MIMO
Adapting MIMO for Military Use

Multiple-Input, Multiple-Output (MIMO) communication systems have the potential for a 10-20x improvement in channel capacities in the spectrum limited JTRS bands under dynamic urban NLOS multipath channel conditions where conventional techniques degrade

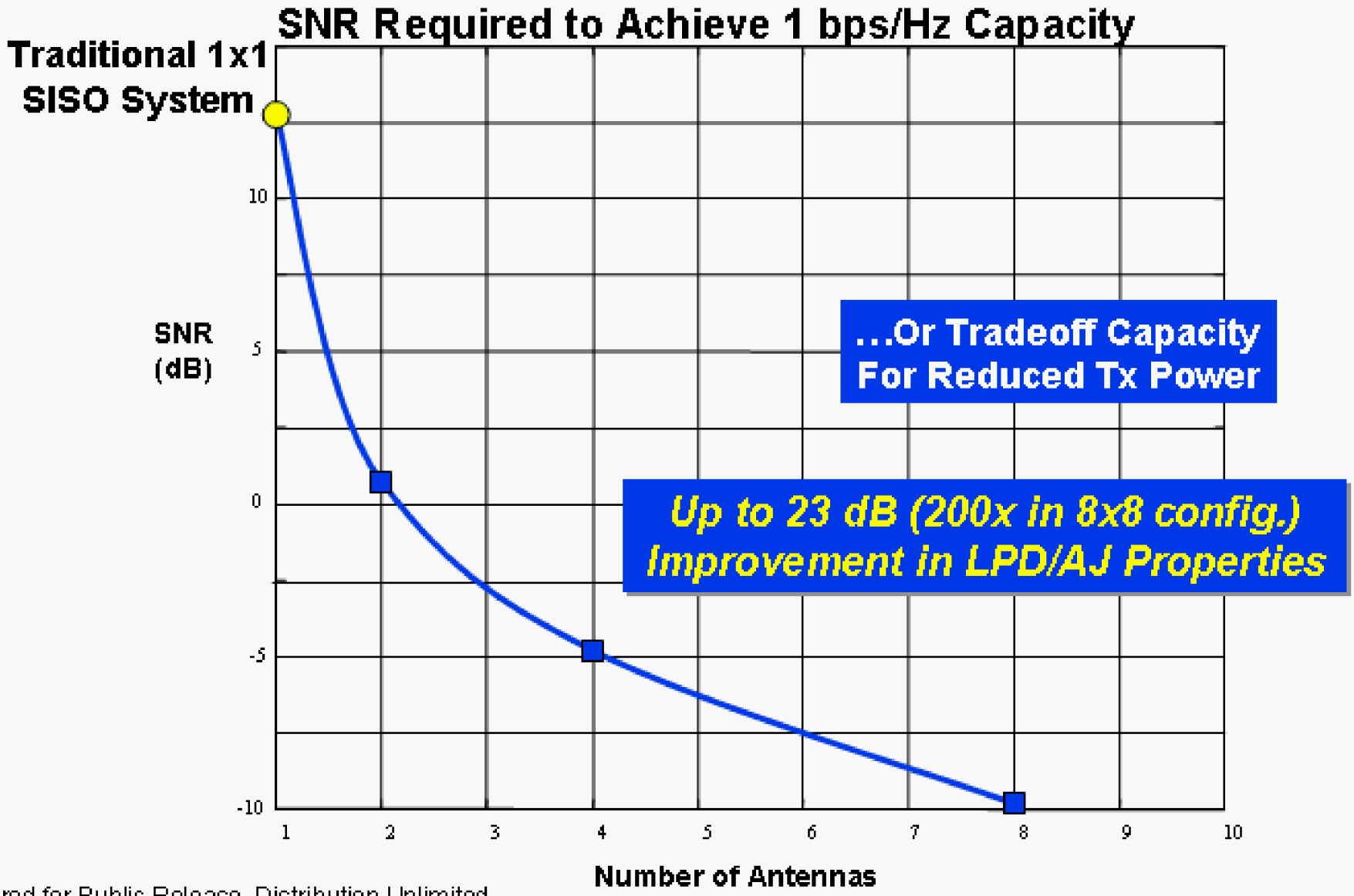


MIMO Can Be Adaptable

- Mobility: Mounted and Dismounted
- Data rate
- Frequency
- Bandwidth
- Anti Jam
- LPD
- Channel utilization
- Antenna number and placement
- Urban and rural

MNM Takes Advantage of the Adaptability of MIMO

MIMO Capacity Can Be Used In Other Ways…

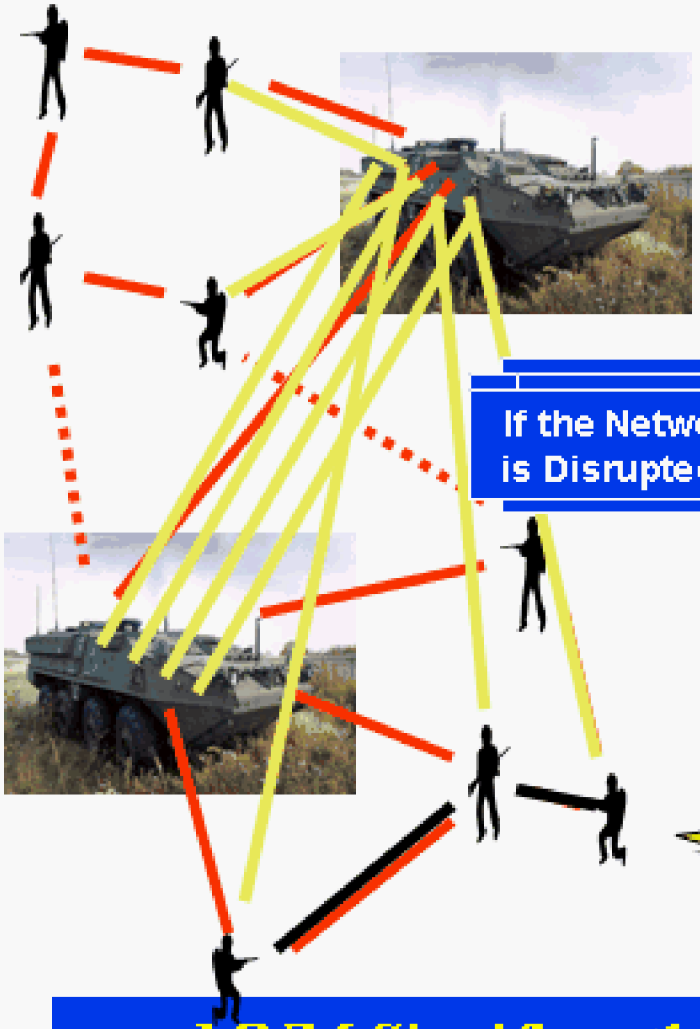


MNM PHY Testing at NAES Lakehurst

- Demonstrated Mobile MIMO
- Multiple MIMO Configurations of 8x10, 4x10, 2x10, 1x10, 2x2 and 1x2
- Line-of-sight and Non-LOS
- Demonstrated up to 40 mph

Mobile MIMO Works!

MNM: MIMO to the Soldier



MIMO exploits the spatial diversity (multipath) created by having more than one T/R unit and antenna at each end of a radio link.

This diversity can be used:

- With spatial multiplexing to achieve higher data rates
- Improve AJ/LPD performance
- Reduce power consumption
- Trade off for more simultaneous channels
- Allow more reliable communications

Radios can be ganged together to increase performance

- Data rate adapts linearly, range increases, and/or improved LPI / AJ / Security
- All adaptively traded – scaled as MIMO capability is combined by combining radios

DARPA Payoff

- Realizing the potential of the dynamic degrees of freedom in MIMO PHY
- Developing MIMO aware ad-hoc network

MNM Significantly Improves Data Rates and Reliability